PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Milan Kokta, et al.		
Title:	SPINEL ARTICLES AND METHODS FOR FORMING SAME		
App. No.:	10/669,135	Filed:	September 23, 2003
Examiner:	Matthew J. Song	Group Art Unit:	1722
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MS AMENDMENT
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. §1.132

I, Jennifer Stone-Sundberg, hereby declare and state:

1. I am a co-inventor of the above-identified patent application and an employee of Saint-Gobain Ceramics & Plastics, Inc.

2. I received my PhD in Chemistry from Oregon State University, Corvallis in 2001.

3. I have been engaged in the field of crystals, and in particular melt-based single crystal growth technologies, since 1999.

4. I have reviewed the Office Action dated January 10, 2008, as well as the prior art cited therein.

5. The claimed invention is drawn to a Czochralski method of forming single crystal spinel wafers from a melt. According to the invention, a spinel single crystal boule is grown from a melt, the boule having the general formula of $aAD \cdot bE_2D_3$, in which the ratio of b:a is greater than 1.5:1 such that the spinel is rich in E_2D_3. Thereafter, the boule is sliced into wafers. Of particular significance, the single crystal boule is formed at a process aspect ratio of not less

than about 0.44. The process aspect ratio is defined as a ratio of average boule diameter to crucible inside diameter.

The claimed process aspect ratio in the context of the Czochralski method is responsible for quite significant properties of the boule. Namely, by growing the boule at a process aspect ratio not less than about 0.44, and in particular, at process aspect ratios of not less than 0.50, undesirable crystallographic "flipping" is prevented. In addition, multiphase (crystallographic twinning, the boule having multiple crystal phases), is also prevented.

The forgoing beneficial effects of forming spinel boules at a high aspect ratio were discovered by my co-inventors and me *empirically*, the crystallographic effects not being predicted by any particular scientific theory or formulaic methodology. Indeed, we found the benefits of high process aspect ratio to be quite surprising, and today still remain unclear on the precise technical reasons why high process aspect ratio in the context of non-stoichiometric spinel crystal growth has been shown to have benefits mentioned above.

Such a discovery is surprising in view of conventional wisdom in the single crystal growth arts. Typically, crystal growth scientists observe improved crystal quality by minimizing the mass of the growing crystal relative to the mass of the melt from which it is drawn. That is, by minimizing the mass of the growing boule relative to the melt, a large melt fraction is maintained in the crucible, which helps ensure homogeneous crystal growth and undesirable shifts in the stoichiometry of the melt. Minimizing the mass of the growing crystal relative to the melt dictates a <u>low</u> process aspect ratio. For many crystal chemistries, process aspect ratios of greater than 0.44, and in particular greater than 0.50 lead to inhomogeneous crystals of undesirable stoichiometry.

In contrast, my co-inventors and I empirically discovered that for the claimed non-stoichiometric spinel crystals, process aspect ratios of not less than 0.44 and in particular, not less than 0.50, lead to improved crystal growth with higher yield. In fact, through experiments, we discovered that crystals having the desired <111> orientation can be formed at process aspect ratios of significantly greater than 0.50, for example, 0.59.

I further concur with Dr. Kokta, as expressed in a Declaration signed February 15, 2007, that not only does the prior art fail to recognize issues like crystallographic flipping and crystallographic twinning associated with Czochralski growth of spinel boules, but also fails to suggest utilizing a high aspect ratio to address those technical issues. Indeed, based upon my years of experience in the crystal growing field and the experience of my colleagues including my co-inventors, I personally find the attendant benefits of utilizing a high process aspect ratio (not less than about 0.44) to be surprising and unexpected, and believe that one of ordinary skill in the art would find the attendant results to be unexpected.

In regard to the Wachi et al. (JP 2001-080989, hereinafter "Wachi"), the disclosure and in particular, the range of process aspect ratios are specific to GaAs crystal systems. Although Wachi states that such disclosure may extend to similar crystal chemistries, such as InP, GaP, and InAs, one of ordinary skill in the crystal growth arts would not have applied the disclosed ranges to chemistries as different from GaAs as stoichiometric and non-stoichiometric spinel chemistries. Moreover, even within the GaAs system, Wachi discourages use of high process aspect ratios, stating that the solid-liquid interface is not stabilized at such high process aspect ratios, leading to low yield.

In contrast, my co-inventors and I discovered that using high process aspect ratios of not less than 0.44, and in particular, not less than 0.50, can produce non-stoichiometric spinel crystals with desirable <111> orientation and high yield.

6. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like, so made, are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

7/28/2008
Date

Respectfully submitted,

Jennifer Stone-Sundberg, PhD